Fishery Management Report No. 02-03

Fishery Management Plan for Arctic Grayling Sport Fisheries along the Nome Road System, 2001–2004

by

Fred DeCicco

April 2002

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

FISHERY MANAGEMENT REPORT 02-03

FISHERY MANAGEMENT PLAN FOR ARCTIC GRAYLING SPORT FISHERIES ALONG THE NOME ROAD SYSTEM, 2001 - 2004

by
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Division of Sport Fish

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The Fishery Management Reports series was established in 1989 for the publication of an overview of Division of Sport Fish management activities and goals in a specific geographic area. Fishery Management Reports are intended for fishery and other technical professionals, as well as lay persons. Fishery Management Reports are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone regional peer review.

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PREFACE

The Alaska Department of Fish and Game (ADF&G) is the fish and wildlife management agency for the State of Alaska. The Sport Fish Division is the management division within ADF&G that is responsible for the management of sport fisheries. The goals of Sport Fish Division are to conserve wild stocks of sport fish, to provide a diversity of recreational fishing opportunities, and to optimize social and economic benefits from recreational fisheries for all Alaskans. To accomplish these goals the Division has instituted a fisheries management process that relies on sound scientific principles and public involvement. Part of this process is the development of Sport Fish Management Plans for sport fisheries that are important to the public or that have characteristics that require focused management.

The Sport Fish Management Plan for Arctic grayling along the road system of Nome was a result of the public process, which included the regulatory prescription handed down by the Alaska Board of Fisheries. The open regulatory process of the Board of Fisheries enabled numerous opportunities for public participation in the development of regulations relating to this plan. The objectives found in this plan were developed around the implied intent of the regulatory process and the best available scientific information. The objectives should be viewed as dynamic and therefore should continue being the focus of discussions among managers, the public, and the Alaska Board of Fisheries. Arctic

INTRODUCTION

BACKGROUND AND HISTORICAL PERSPECTIVE

The Nome area is unique to rural Alaska because of the presence of a fairly extensive road system. Three roads (over 200 miles in total) stretch approximately 70 miles to the northwest, east and north from the community of Nome. Many streams located along the southern half of the Seward Peninsula between the villages of White Mountain and Teller, (Figure 1) are accessible via the road system and offer the opportunity to sport fish for Arctic grayling, *Thymallus arcticus*. Streams along the Nome-Teller road include the Snake, Penny, Cripple, Sinuk, Feather, Tisuk and Bluestone rivers. Streams accessible from the Nome-Council Road include the Flambeau, Eldorado and Bonanza rivers (boat access only) and the Solomon, Fox, and Fish/Niukluk rivers. Streams along the Nome-Taylor Highway include the Nome, Grand Central, Pilgrim, Kuzitrin and Kougarok rivers. All but a few streams (Tisuk, Cripple and Penny) contain populations of Arctic grayling and offer sport fishing opportunity for this resident species. Arctic grayling, larger than 1.4 kg (3 lbs), are present in many southern Seward Peninsula waters and some of Alaska's largest Arctic grayling have been taken there (ADF&G Trophy Fish Program records, unpublished). Other species present in these rivers include Dolly Varden *Salvelinus malma*, round whitefish *Prosopium cylindraeium*, humpback whitefish *Coregonus pidschian*, Chum salmon Oncorhynchus keta, coho salmon *Oncorhynchus kisutch*, pink salmon *Oncorhynchus gorbuscha*, red salmon *Oncorhynchus nerka*, ninespine stickleback *Pungitius pungitius* and slimy sculpin *Cottus cognatus*. A few drainages also contain king salmon *Oncorhynchus tshawytscha*, burbot *Lota lota*, longnose sucker *Catostomus catostomus*, northern pike *Esox lucius*, broad whitefish, *Coregonus nasus*, Bering cisco *Coregonus laurettae*, least cisco *Coregonus sardinella* and Alaska blackfish *Dallia pectoralis*.

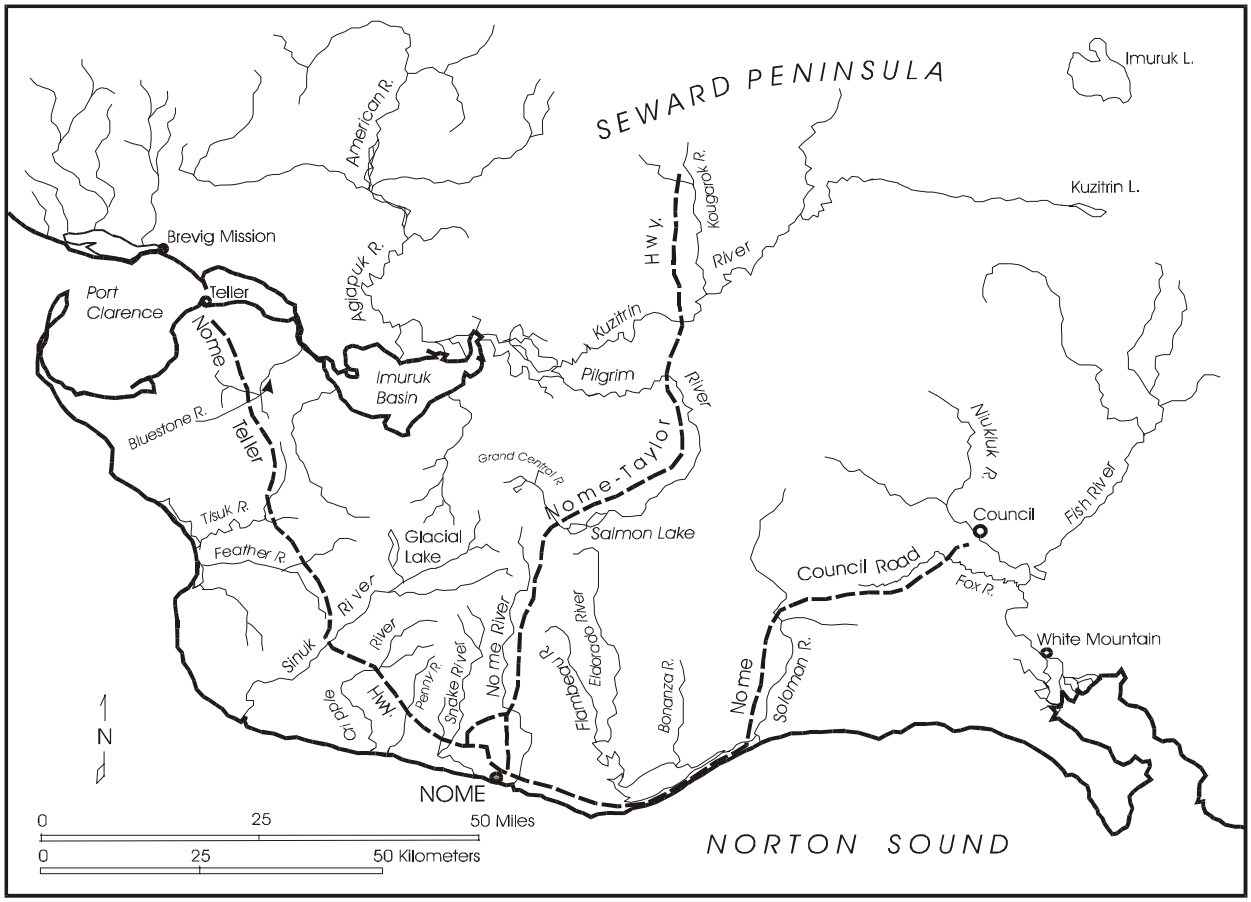

Figure 1.-Southern Norton Sound with the Nome area road system and road accessible waters.

Arctic grayling are the most commonly caught and fourth most commonly harvested species in roadside fisheries on the Seward Peninsula (Table 1). In general, the sport fisheries for grayling in Seward Peninsula roadside streams are small with estimated average annual harvests (1983-2000) of about 2,000 fish. Harvests have declined in recent years with the average annual harvest from 1996-2000 estimated at about 735 Arctic grayling. Stock status data suggest that most Arctic grayling populations along the Nome road system are healthy, and the decline in harvest is likely due to more restrictive regulations and a shift in angler preference toward catch-and-release in recent years.

Since 1989, the stock status of grayling populations in several of the more popular rivers has been investigated (DeCicco 1990-1999, 2002; DeCicco and Wallendorf 2000). The Nome and Solomon river stocks were found to be over-exploited and at very low levels of abundance, and the Niukluk, Fish, Pilgrim, Snake and Sinuk rivers populations are believed to be sustaining current levels of harvest. Grayling densities in most Seward Peninsula rivers are low relative to interior Alaska streams. They have ranged from low-density populations of about 20 to 60 grayling per mile in the Nome and Sinuk rivers (almost nonexistent in the Solomon River), to about 200 grayling per mile in the lower Pilgrim River (DeCicco 1990-1998). Higher density populations in the Niukluk and Fish rivers were about 375 grayling per mile in 1991 (DeCicco

Table 1.-Estimated harvest and catch of Arctic grayling from Nome area roadside streams, 1983-2000[a].

	Arctic grayling estimated harvests in Nome roadside streams 1983-2000																		Average	Average
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	(91-00)	(96-00)
Eldorado	0	52						33	57	60	0		35	0	0	0		0	19	0
Fish/Niiukluk	5,160	376	945	1,114	2,119	1,237	808	415	1,320	158	619	644	430	313	734	16	1,029	442	571	507
Kuzitrin	371	195	195	189	181	1,255	283	133	286	0	101	98	44	315	108	41	23	64	108	110
Nome	464	376	528	491	344	946	2,032	33	186	0	0	16	0	0	0	0	0	0	20	0
Pilgrim	761	247	319	227	272	109	516	415	459	91	75	49	52	73	81	0	11	58	95	45
Sinuk	130	428	0		724	73	51	0	129	0	37	8	18	97	0	8	11	0	31	23
Snake	278	26	139	378		709	101	116	402	16	467	32	18	121	0	8	113	16	119	52
Solomon	0	0	0	0	91	127	152	17	158	0	0	0	0	0	0	0	0	0	16	0
Total	7,164	1,700	2,126	2,399	3,731	4,456	3,943	1,162	2,997	325	1,299	847	597	919	923	73	1,187	580	975	736

	Arctic grayling estimated catches in Nome roadside streams 1990-2000																		Average	Average
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	(91-00)	(96-00)
Eldorado								133	172	60	93		53	243	0	0		0	78	61
Fish/Niiukluk								2,189	7,261	2,171	5,976	2,398	1,169	4,653	10,452	8,159	7,414	1,662	5,132	6,468
Kuzitrin								298	1,349	481	288	351	192	388	1,041	41	162	859	515	498
Nome								613	1,363	90	569	1,111	571	497	569	207	300	10	529	317
Pilgrim								1,476	4,463	526	2,362	266	370	821	429	65	694	221	1,022	446
Sinuk								232	1,291	300	879	417	498	339	1,464	25	22	29	526	376
Snake								199	2,096	158	1,614	377	887	1,055	123	218	723	449	770	514
Solomon								33	602	38	140	212	200	97	703	0	21	853	287	335
Total								5,173	18,597	3,824	11,921	5,132	3,940	8,093	14,781	8,715	9,336	4,083	8,842	9,002

[a] Data from Mills 1984-1994, Howe et al. 1995, 1996, 2001a, b, c, d, Walker *In prep*.

1992). More recent data show that densities in the Niukluk River have increased to about 470 grayling per mile in 1998 and to about 500 per mile in the Fish River in 1999 (DeCicco 1999, DeCicco and Wallendorf 2000). In contrast, interior Alaskan populations often exceed 500 fish per mile (Roach 1995, Fleming 2001, Gryska 2001, *In prep*). The average size of grayling from Seward Peninsula rivers is generally large and they are generally older and larger when they first spawn than grayling in Interior Alaska streams. Scales have been found to be unreliable structures for determining age in older fish. The oldest Arctic grayling aged with an otolith from a river on the Seward Peninsula has been a 31 year old fish from the Eldorado River (DeCicco, *unpublished*). Since Arctic grayling in this area commonly live more than 20 years, some survive to grow very large, particularly in rivers where fishing effort is light. For example in the lightly exploited Sinuk River almost 70% of the 1991 sample was age-8 or older (scale age) and the average total length of all fish sampled was almost 19 inches (DeCicco 1992). However, the density of fish was low, approaching that of the Nome River that was one of the most heavily exploited streams in the area.

The Seward Peninsula has long been known for its production of large sized Arctic grayling with approximately 25% of all trophy grayling registered with the ADF&G's trophy fish program coming from this area. Of the 110 Arctic grayling registered in that program, 30 were taken from Seward Peninsula waters, and 20 of those were taken from the Sinuk River. Since Arctic grayling are resident in separate, often small, streams, they must be managed as independent units with regulations designed to address the characteristics of individual populations or groups of similarly structured populations.

POPULATION STATUS OF ARCTIC GRAYLING IN NOME ROADSIDE STREAMS

NOME-TELLER ROAD STREAMS

Of the seven streams crossed by the Nome-Teller Road, the Bluestone, Feather, Sinuk and Snake rivers contain populations of Arctic grayling.

The Bluestone River flows northeast from tundra hills located on the west side of the road and crosses under the road about 58 miles west of Nome. From the bridge it flows about 12 miles northeastward and enters Tuksuk Channel between Grantley Harbor and Imuruk Basin. Little is known about the grayling population in the Bluestone River, and it receives little angling pressure. Local lore suggests that during road construction, this was a favorite place for angling by the road crew, and a number of large Arctic grayling were removed from this stream at that time. The present quality of the grayling fishery in this stream is unknown, and it is likewise not known if this population has ever recovered from the early fishery. No population data on Arctic grayling are available from the Bluestone River.

The Feather River drains the south slopes of the Kigluaik Mountains, crossing under the road about 38 miles west of Nome. It then flows about 10 miles before entering a coastal lagoon just north of Cape Wooley. The Feather River receives little sport fishing pressure, and little is known about its Arctic grayling population, but it is thought that the population is small. No population data on Arctic grayling are available from the Feather River.

The Sinuk River is 75 km in length and drains a 794 sq km area of the southeast side of the Kigluaik Mountains. The river flows in a southwesterly direction and enters the Bering Sea at 64^{o} 35' N, 166^{o} 15' W. approximately 44 km west of Nome. Major tributaries of the Sinuk River

include the catchment of Glacial Lake and the Stewart River. The section of the Sinuk River from about three miles downstream from its confluence with Windy Creek to the Teller Road bridge (40 km) has been chosen as an index area for this drainage, and repeated sampling has occurred throughout this reach in order to describe the baseline population structure to which future stock assessments may be compared. Abundance or size composition data are available for years 1989-1993 (DeCicco 1990-1994). The average abundance within the index section over those years was about 1,350 Arctic grayling. Of the assessed population, about 96% was more than 15 inches in total length. Over the past 10 years, about 600 Arctic grayling have been captured annually from the Sinuk River, of which only about 35 have been harvested (Table 1).

The Snake River is approximately 57 km in length. It drains the area south of the Sinuk River between the Nome River to the east and the Penny River to the west, entering the Bering Sea at 165°25'W, 64°30'N. The lower reaches of the Snake River serve as the port for the city of Nome. The Glacier Creek Road is a gravel road that parallels the river for much of its length and provides access from the east side. The Snake River sustains an estimated average annual effort of about 1,300 angler days; about 770 Arctic grayling are estimated to be caught annually since 1983, of which about 120 are harvested annually from the Snake River since 1990 (Table 1). In the past five years, about 500 Arctic grayling were estimated to have been caught annually with an estimated annual harvest of about 50 fish (Table 1). A 40-km section of the Snake River from the confluence of its source streams (Goldbottom and Silver creeks) downstream to the mouth of Anvil Creek, 12 km downstream of the bridge on the Nome - Teller road, has been sampled several times. This section extends throughout what we believe to be the area inhabited by most of the Arctic grayling in the entire watershed and has resulted in whole river estimates of population parameters. More recently, a smaller index area from Boulder Creek to the bridge located at approximately 8 mile on the Nome-Teller Highway has been used as an index area for population assessment. In addition to the first length data from 1988, abundance and size composition data are available from 1991-1994, and 2001 (DeCicco 1992-1995, Gryska *In prep*). The estimated population abundance in the index area on the Snake River has been maintained at between 1,000 and 1,200 fish with about half the population over 15 inches in total length, under the current daily bag and possession limit of two Arctic grayling per day with only one over 15 inches in length.

NOME-TAYLOR HIGHWAY STREAMS

The Nome River has its headwaters in the Kigluaik Mountains. It flows south and enters Norton Sound 5.6 km east of Nome at 166° 35'W, 64° 29'N. It is 70 km in length and drains 245 km^2. The Nome River is accessible from the Nome-Taylor Highway that parallels its entire length. The Nome River has been sampled several times resulting in comparative estimates of abundance and size composition. An index area from Hobson Creek to the salmon counting weir approximately 3 km upstream from the lagoon has been used for comparative population assessment during recent years. Abundance and size composition data are available from 1991, 1992, 1997 and 2000 (DeCicco 1992, 1993, 1998, 2002). Historically, the Nome River has sustained more angling pressure than any other single stream in northwestern Alaska (Table 2). The Arctic grayling population in the Nome River has been overexploited and the river is closed to all Arctic grayling fishing. Abundance of Arctic grayling in the Nome River was most recently estimated at about 550 fish in 2000 (DeCicco 2001). It is hoped that the population can be restored to about 2,500 fish and sport fishing can be resumed in the future.

Table 2.-Estimated number of anglers and angler days of sport fishing effort on Nome roadside streams 1983-2000[a].

River	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Average (91-00)	Average (96-00)
Angler days of effort estimated in Nome roadside streams 1983-2000																				
Cripple	179			170	181	509	257	813	221	149	1,121	320	272	307	166	2,303	66	614	554	691
Eldorado	30	279						381	246	480	95		217	68	60	40		106	164	69
Fish/Niiukluk	1,999	1,115	889	1,888	2,473	2,245	2,124	2,059	2,524	2,742	3,962	3,082	2,603	2,120	3,017	1,344	4,916	3,350	2,966	2,949
Kuzitrin	179	279	84	318	1,392	1,037	313	572	836	469	463	643	413	483	440	201	355	697	500	435
Nome	3,908	5,714	6,514	6,023	1,865	6,058	6,569	7,194	4,646	6,455	3,633	5,116	3,044	2,920	1,914	1,371	1,463	1,455	3,202	1,825
Penny				396	34	91	34	343	61	37		101	43	80	15				56	48
Pilgrim	597	732	375	868	1,159	4,822	1,678	1,710	3,183	1,184	1,195	844	1,253	1,348	820	546	433	753	1,156	780
Sinuk	477	366	806		5,198	1,055	906	343	885	1,504	874	1,132	1,295	553	443	123	244	294	735	331
Snake	119	418	361	850		2,128	436	775	2,384	2,379	1,468	880	1,968	1,269	445	376	977	377	1,252	689
Solomon	30	766	2,667	102	272	309	492	458	1,057	962	1,404	1,193	781	335	434	340	438	242	719	358
Total	7,518	9,669	11,696	10,615	12,574	18,254	12,809	14,648	16,043	16,361	14,215	13,311	11,889	9,483	7,754	6,644	8,892	7,888	11,248	8,132
Number of anglers estimated to have fished in Nome roadside streams 1983-2000																				
Cripple				102	101	155	66	66	108	37	125	91	78	164	75	513	64	120	138	187
Eldorado		123						50	144	162	91								132	
Fish/Niiukluk		521	466	850	809	866	641	580	881	773	832	766	918	692	722	227	834	507	715	596
Kuzitrin		153	103	204	135	217	115	282	414	287	293	267	214	230	236	141	197	111	239	183
Nome		1,288	1,220	1,087	674	1,733	1,231	1,625	1,277	1,433	1,181	1,025	859	947	691	636	564	450	906	658
Penny				306	34	31	33	66	36	37		78	42	40	15				41	28
Pilgrim		398	363	238	438	836	1,050	862	1,169	686	570	323	531	562	456	392	283	177	515	374
Sinuk		306	311		405	464	230	116	557	436	463	463	485	376	235	75	78	155	332	184
Snake		245	129	136		340	148	298	647	461	622	341	640	433	235	164	313	185	404	266
Solomon		215	391	102	270	155	263	216	593	685	317	328	426	230	250	245	193	88	336	201
Total		3,249	2,983	3,025	2,866	4,797	3,777	4,161	5,826	4,997	4,494	3,682	4,193	3,674	2,915	2,393	2,526	1,793	3,649	2,660

[a] Data from Mills 1984-1994, Howe et al. 1995, 1996, 2001a, b, c, d, Walker *In prep*.

The Grand Central River has its sources in several small mountain lakes on the southeast slopes of the Kigluaik Mountains in the vicinity of Mt. Osborne. It is approximately 16 km in length and drains a broad valley before being crossed by the road at mile 35. It then flows about 4 km farther and enters Salmon Lake at its south end. The river has a very small population of Arctic grayling that are likely an extension of the Salmon Lake population. The river has never been systematically sampled, and no quantitative data exist on its Arctic grayling population.

The Pilgrim River is approximately 72 km in length. It originates in Salmon Lake, flows north and then east entering the Kuzitrin River at approximately 165° 15'W, 65° 10'N. It then enters Imuruk Basin with the Kuzitrin River. There is a Bureau of Land Management campground at the outlet of Salmon Lake, and from there the river can be floated for about 25 river miles to the bridge at mile 65 of the Kougarok Road. Riverboats can be launched at the bridge for access to downstream locations. In the past 5 years, the Pilgrim River has sustained an estimated average annual effort of about 1,150 angler days and, although over 400 Arctic grayling are caught there annually, only about 45 are harvested (Tables 1 and 2). The 12 km section of the Pilgrim River just downstream from the bridge has served as an Arctic grayling index area for the drainage. This is also the area of the Pilgrim River that supports the most angling. The upper river from Salmon Lake downstream to the bridge has been sampled on two occasions. In addition to length samples obtained in 1988, abundance and size composition data are available for 1990 – 1996 (DeCicco 1991-1997). Over the past 10 years about 1,200 Arctic grayling have been captured annually from the Pilgrim River, of which only about 180 have been harvested (Table 1).

The Kuzitrin River is crossed by the road at mile 68 and is navigable by jet boat both upstream and downstream from the road crossing. The river drains an extensive wetland area and has its sources in the lava fields of the central Seward Peninsula. Kuzitrin Lake is located at its headwaters. The Kuzitrin River contains a large variety of species including northern pike, burbot, longnose sucker, and several species of whitefish that are not present in smaller area streams. A sample of Arctic grayling was collected from the Kuzitrin River in 1988, but no abundance data have been collected from the river. The Kuzitrin River sustains a moderate amount of angling. Over the past 10 years, about 500 Arctic grayling have been captured annually from the Kuzitrin River, of which only about 130 have been harvested (Table 1).

The Kougarok River is a major tributary to the Kuzitrin River and is crossed by the road at mile 86. This small stream has a population of Arctic grayling and a few Dolly Varden spawn there. It sustains a small amount of angling pressure. The grayling population has never been sampled. This river's grayling population should be considered part of the Kuzitrin population for management purposes.

THE NOME – COUNCIL HIGHWAY STREAMS

Safety Sound (mile 22-33) provides boat access to the Flambeau, Eldorado and Bonanza rivers. These parallel drainages flow from the hills to the south of Salmon Lake between the Nome and Niukluk rivers. Little is known about the populations of Arctic grayling in the Flambeau and Bonanza Rivers. The Eldorado River population has been sampled several times, and length and age data are available. Sport Fish Division has conducted an age validation study of Arctic grayling in this stream, and it is from this study that the

extreme longevity of Seward Peninsula Arctic grayling has been described (DeCicco, *unpublished*). One fish was aged at 31 years. Length samples were also obtained in association with this study. Data are available from 1994, 1995, and 1996 (DeCicco 1995-1997). Most angling on these streams is in their lower reaches, and none receive appreciable effort during the open water period.

The Nome-Council Highway parallels the Solomon River for about 10 miles. The Solomon River is about 65 km in length and drains the area between the Bonanza River and the Fish River. It enters the east end of Safety Sound and also has a direct outlet in to Norton Sound. Like the Nome River, this river's very small population of Arctic grayling has been overexploited and the river has been closed to sport fishing for Arctic grayling fishing since 1992. Very few Arctic grayling were sampled from this river in 1997 and the river was closed to subsistence fishing for Arctic grayling by the BOF in December 2000.

The highway crosses over the Fox River after following it for about 10 miles as both descend from Skookum Pass toward the Niukluk River to which the Fox is tributary. Other than a small sample obtained from the Fox River in 1977, little is known about its Arctic grayling population, however, it is likely that its population is closely tied to the population found in the Niukluk River and consequently should be healthy. Most angling in the Fox River occurs near the bridge crossing. No systematic sampling of this population has taken place.

The town of Council is located at the end of the Nome-Council Road on the Niukluk River about 15 miles from its confluence with the Fish River. Two guiding operations with small lodges are located on the Niukluk River. In addition, Nome based guides fish the river as well as other road accessible waters. Many residents of Nome have summer cabins on the Niukluk River at Council or fish camps along the river. Since the construction of the bridge over Safety Sound in 1980, and improvements to the road, access to the Fish/Niukluk rivers has increased, and this area has become a prime destination for the road-bound angler. The drainage sustains an average annual effort of about 2,400 angler days (Table 2). About 550 Arctic grayling are harvested annually from the Fish/Niukluk rivers from an average catch of about 5,300 fish (Table 1). Length data were collected from the Niukluk and Fish rivers in 1979-1984 (Alt 1985). In addition, abundance and length data were collected in 1990, 1991, 1998 and 1999 (DeCicco 1991,1992, 1999, DeCicco and Wallendorf 2000). Abundance in index sections of the Fish and Niukluk rivers more than doubled between 1990-1992 and 1998-1999 to 7,900 fish in the Fish River section and 5,000 in the Niukluk River section. At the same time the size composition in both rivers also increased. In the Fish River, almost the entire sampled population was over 15 inches in total length during both time periods, but there was a greater proportion of fish over 19 inches long in 1999 than in 1991. In the Niukluk River, 65% of the sampled population was over 15 inches in total length during 1990 while the entire sampled population was over 15 inches in length during 1998. These data suggest that both populations were depressed in the late 1980's and have since recovered. This is likely due to the adoption of the current daily bag and possession limit of five Arctic grayling with only one that can be over 15 inches in 1988, and a change in angling practices to more catch-and-release fishing.

HISTORICAL PERSPECTIVE

Nome area Arctic grayling fisheries have been popular since before statehood, and have increased in magnitude as the city of Nome has continued to grow over the past two decades. The sport fisheries occur almost entirely during open water, from June through September. Anglers target grayling throughout road and boat accessible sections of rivers and some of their tributaries. A winter subsistence fishery for Arctic grayling occurs on the Fish and Niukluk rivers with most participants originating from White Mountain. Winter ice fisheries occur in other drainages, but most are targeting Dolly Varden, with Arctic grayling sometimes taken as incidental catch.

The Arctic grayling fisheries around Nome and accessible from the Nome road system have been influenced by several factors over the past thirty years. Increased access due to road improvements and bridge construction has allowed increased opportunity for anglers. The availability of the ATVs and four-wheelers has also provided additional access to many areas. As recent as the mid 1970s, a road trip to Council or to the Pilgrim River bridge on the Taylor Highway was a significant undertaking and now it is a 90 minute trip in a 2-wheel drive automobile. Regulation changes have also played a part in changing the character of Nome's Arctic grayling fisheries. Prior to 1988, the daily bag was a combined 15 fish "trout, grayling or char" limit with two fish permitted over 20 inches in length and two daily bag limits allowed in possession. This was interpreted locally as a limit of 30 grayling for a weekend, and many Nome anglers returned home on a Sunday with their legal limit. A significant improvement in access occurred around 1980 with the construction of the Safety Sound Bridge. The combination of the "frontier" attitude, increasing human population, liberal bag limit, and improved access to fishing areas affected all accessible Arctic grayling populations, some more than others. In 1988, the Alaska Board of Fisheries (BOF) established a separate daily bag and possession limit for Arctic grayling in Norton Sound at 5 per day of which only one was allowed over 15 inches. The effect of this single change in regulation can be seen in the harvest estimates that averaged about 4,300 annually from 1980-1988, and dropped to an average of 1,400 annually between 1989 and 1997. The other factor that has influenced Arctic grayling fisheries around the Nome area has been a change in the attitude of many anglers who now recognize the quality of their local fisheries, and an increase in the practice of catch-and-release fishing.

The Statewide Harvest Survey provides estimates of harvest and catch by species and river, and estimates of effort by river. These estimates are used to determine trends in fisheries by river or region, and to alert managers to significant changes in fisheries that may be considered "red flags" for the focus of research projects, or the potential location of growing management concerns. Only rivers with sufficient responses to the survey are reported separately, so accurate data on smaller streams is seldom reported. The major drainages along Nome's road system, such as the Nome, Pilgrim, Snake, Sinuk and Fish/Niukluk, usually break out separately, and data from the SWHS are useful in tracking the characteristics of these separate fisheries.

From 1977 through the early-1990s, the amount of sport fishing effort on the Seward Peninsula and Norton Sound increased almost three fold to about 23,000 angler days. Effort in Nome roadside streams showed a similar trend reaching a high of over 18,000 angler days in 1988. Effort remained between 13,000 and 16,000 angler days through the

early 1990s and has declined to an average of about 8,000 angler days annually during the past five years (Table 2). Over the same time period, the proportion of sport caught Arctic grayling that were harvested has dropped from about 17% (1990-1995) to about 8.6% (1996-2000). This trend coupled with the reduction in the background regulation in 1988 is probably responsible for the stabilization of harvest at about 1,200 Arctic grayling for the region, and about 600 to 800 annually for the roadside component (Table 1).

LIFE HISTORY AND STRUCTURE OF ARCTIC GRAYLING IN SEWARD PENINSULA WATERS

For many years, based on brief "surveys" where fish were captured, measured and aged with scales, the ADF&G thought that Arctic grayling populations in Seward Peninsula waters were structured similarly to those in Interior Alaskan streams. They were thought to live for 10 or 12 years, and since it was known that they reached a large size, it was thought that they grew more rapidly than those in Interior Alaska (Alt 1985, Holmes 1985, Merritt 1989, Tack 1973) or from the Kuskokwim River (Alt 1977). It was also noted that there was a conspicuous lack of small grayling in most waters sampled (Merritt 1989). Since those early years, it has been learned that Arctic grayling in Seward Peninsula waters owe their large size to two factors. The first factor is that Seward Peninsula Arctic grayling grow very rapidly through age-6 or age-7. DeCicco (1990) found that six year-old Arctic grayling from the Niukluk and Sinuk Rivers had mean fork lengths of 352 mm and 432 mm. In contrast, six year-old Arctic grayling from the Chena and Salcha rivers had a mean fork lengths of 290 mm (Ridder 2000) and 306 mm (Ridder et al. 1993). The rapid early growth of Arctic grayling in Seward Peninsula streams is thought in part due to the presence of large runs of pink salmon in most streams. Pink salmon provide nutrients to streams, in effect, carrying the productivity of the marine environment back into freshwater. Grayling benefit by feeding on pink salmon eggs, fry, flesh and the insects that also benefit from the increase in stream productivity brought by salmon. The mean annual length increase of tagged Arctic grayling of all sizes in the Snake River was 24 mm and 21 mm in 1991 and 1993, years of low pink salmon abundances. However, in 1992 and 1994, years of high pink salmon abundances, the mean annual length increase of tagged Arctic grayling in the Snake River was 29 mm and 39 mm (DeCicco 1995). Once reaching maturity, Seward Peninsula Arctic grayling spawn annually and channel most of their energy into reproduction. Consequently, after reaching a large size rapidly, their growth slows. The mean length increase of Arctic grayling larger than 350 mm recaptured in the Sinuk River in 1991, one year after marking, was 5.2 mm and the mean length increase after one year in the Fish River was 8.1 mm (DeCicco 1992). In the Snake River, one-year length increase of 428 Arctic grayling smaller than 15 inches averaged 32 mm (10%) while that for 165 Arctic grayling larger than 15 inches averaged 9 mm (2%) (DeCicco, *unpublished data*). Arctic grayling in Seward Peninsula streams are long-lived and can ultimately reach very large size. Accurate ages cannot be obtained using scales, and recently Arctic grayling from the Nome area have been aged at over 30 years using their ear bones (otoliths) (DeCicco, unpublished data). Even though Arctic grayling grow slowly after reaching 15 inches in length, they can reach a large size because they may live many years.

This summary of Arctic grayling population structure applies in a general way to all Seward Peninsula populations. However, the structure of each river's population varies depending on stream size, character, amount of exploitation, and the extent of lower river slow-current rearing habitat. Because of these factors, regulations have been developed for separate streams or groups of streams that contain populations sharing similar characteristics or conditions.

RECENT FISHERY ASSESSMENT AND MANAGEMENT ACTIVITIES

Stock assessment projects have been conducted in rivers accessible from the Nome road system since 1989. After experimentation with the use of electrofishing, beach seine and rod and reel as capture methods, the latter two in combination were selected as the most effective way to sample Arctic grayling in these streams. Electrofishing was eliminated because the clear waters of the streams allowed fish to see and avoid the electrofishing boat, and the mortality of other species that were incidentally exposed to the electrical field, especially Dolly Varden, was unacceptably high. Mark-recapture abundance estimates in large index areas of streams have been used to establish baseline data on abundance and size composition of Arctic grayling populations. Such estimates can be used to track the populations over time, or to compare similar parameters in future assessments to determine whether bag limits should be adjusted in order to meet management objectives.

Baseline population data have been collected on Arctic grayling populations in the Fish, Niukluk, Nome, Pilgirm, Snake, and Sinuk rivers. These data, in combination with harvest data from the SWHS have been used to develop regulations that are appropriate in meeting the management objectives of "sustaining the populations at or above base line abundance and size composition" in road accessible waters of the Seward Peninsula.

RECENT FISHERY PERFORMANCE (1999 -2000 SUMMARY AND AVAILABLE INFORMATION FOR 2001)

1999 Summary

Effort in Nome roadside streams increased to an estimated cumulative effort of about 8,900 days fished in 1999 from about 6,650 days in 1998 (Table 1). The increase in effort was primarily in the Fish/Niukluk river drainage where the estimate in 2000 of almost 5,000 angler days was the highest on record and over three times the effort in 1998. Catch increased only slightly to an estimated 9,935 Arctic grayling from 9,200 the previous year and the harvest of Arctic grayling also increased in 1999 to almost 1,200 fish. The vast majority of the estimated harvest from 1997 to 2000 was from the Fish/Niukluk drainage (Table 1). There was no need for in season management action in relation to Arctic grayling fisheries in the Nome area during 1999.

2000 Summary

While effort in 2000 remained similar to past years with a total of 7,888 angler days estimated, both catch and harvest of Arctic grayling were lower than in recent years. Estimated effort level and distribution among streams was almost identical to that estimated in 1997. The estimated catch of Arctic grayling declined to a five-year low of 4,083 while, while estimated harvest declined to 580 Arctic grayling, about half of the

harvest estimated in 1999. There was no need for in-season management action in relation to Arctic grayling fisheries in the Nome area during 2000.

2001 Update

Fishing conditions in Nome area waters have likely been similar to those in 2000, with the exception that moderately high water levels prevailed for most of the summer due to July and August rains. Effort directed toward grayling will likely be similar to past years, although the rainy weather may have reduced effort over the past few seasons. There was no need for in-season management action in relation to Arctic grayling fisheries in the Nome area during 2001.

MOST RECENT REGULATORY ACTIONS

During the January, 2001 Board of Fisheries meeting, two proposals relating to Arctic grayling in the Nome area were heard and acted upon. The two similar proposals related to depressed Arctic grayling populations in the Nome and Solomon Rivers. Both rivers had been closed to sport fishing since 1992. The proposals closed subsistence fishing for Arctic grayling in both drainages. Both were approved by the BOF.

FISHERY OUTLOOK

Except for the Nome and Solomon rivers, the Arctic grayling fisheries along the Nome road system should continue to be of high quality with relatively high proportions of large fish present in the populations. With the current regulatory framework in place, the ADF&G is hopeful that the populations and the quality of fishing will be maintained into the foreseeable future. Periodic population assessments are critical to evaluate the success of the set of regulations that have been developed for these fisheries.

FISHERY MANAGEMENT, CURRENT REGULATIONS

- **Background Regulations for Norton Sound**:

  Season is open all year. Five Arctic grayling may be taken or in possession daily with only one allowed 15 inches or greater in length.

These regulations apply in three general situations. In rivers where little or nothing is known about the status of the population, and effort is known or suspected to be very low, the background regulation applies. Should it become known that effort is increasing in such an area, or should stock assessment data show that the population cannot support even meager harvest, then, changes in regulation could be sought through BOF action or immediately put into effect with an Emergency Order.

In streams that flow rapidly with relatively little slow moving rearing habitat and contain a population of Arctic grayling that is dominated by large old fish, the background regulation provides a functional daily bag limit of one fish. The Sinuk River is a good example of a road system stream falling into this category, however many lightly exploited rivers on the Seward Peninsula fit both of these situations.

The third situation where this regulation is appropriate is for larger river systems with ample slow moving rearing habitat and relatively abundant populations. Fish of all sizes

are present with upstream areas dominated by large older fish. Road accessible waters falling into this category include the Fish, Niukluk and Kuzitrin rivers.

- **Other Regulations**:

  Season is open all year. Two Arctic grayling may be taken or in possession daily with only one allowed 15 inches or greater in length.

These Regulations apply where there is a moderate amount of effort on smaller rivers with relatively abundant slow moving rearing habitat. Populations may be dominated by large sized fish or contain fish of all sizes. Road accessible waters in this category include the Snake and the Pilgrim rivers.

- **Closed Waters:**

  Waters closed to Arctic grayling fishing are those in which the population has been over-exploited resulting in very low abundance. Applicable waters must still have a grayling population and local knowledge should suggest a history of higher abundance and better angling. Road accessible waters in this category include the Nome and Solomon rivers.

- **Nome river restoration efforts:** An attempt at experimental rearing of young of the year Arctic grayling in order to enhance survival over the first winter of life is underway in the Banner Creek gravel pits adjacent to the Nome River. If successful, restoration will be undertaken on a larger scale and may provide a method to rehabilitate the Nome River Arctic grayling population.

- **Other management activities:** Other management activities related to these fisheries in the last several years have involved pubic education regarding the stock status, current regulations and Arctic grayling life history. Regulatory signs have been posted at angler-access sites along most road accessible rivers, and information on catch-and-release techniques has been provided at ADF&G offices. In addition, articles on Arctic grayling life history and longevity have been printed in Nome area newspapers.

- **Summary:** Effort, catch and harvest are monitored through the Statewide Harvest Survey. Based on existing angling practices and effort, harvests of Arctic grayling in Nome roadside streams appear to be occurring at levels that will enable populations to be maintained at existing levels of abundance and size composition. Arctic grayling catches over the past five years have ranged from 10,000 to 20,000 with about a 10% harvest rate. Population structure is shifting toward larger, older fish and stabilizing in some streams, while others have remained relatively stable. Only two known populations have been over-harvested and are in a "depressed' condition. An angling constituency has developed that are shifting toward catch-and-release fishing.

- **Research:** Continued research in the form of periodic Arctic grayling population assessments is critical to the successful management of these populations. Data from periodic assessments will be used to determine if populations are being maintained at earlier levels of abundance and size

composition, and will therefore be the vehicle by which management success will be measured.

Management Planning: Because of the importance of these fisheries and considerable public interest from within and outside the local area, Sport Fish Division staff began a process of developing this management plan. The first step was organizing biological and catch and effort information, and reviewing the development of current management and regulatory options. The criteria for regulatory review were:

1. Regulations permitting harvest must be relatively simple and harvest scenarios will not include in-season monitoring of catch.
2. Regulations must be conservative enough so that expected harvest is sustainable over time, barring exceptional circumstances.
3. Regulations must be liberal enough allow reasonable opportunity and must be tailored to fit individual stream populations.

On a Statewide level, the Alaska Board of Fisheries has directed Region III Sport Fish Division to develop a Regional Management Strategy for Arctic grayling fisheries. Development of that strategic plan began in late 2000 and will incorporate plans such as this one.

FISHERY MANAGEMENT GOALS AND OBJECTIVES

GOALS

The ADF&G intent for the management objectives are to regulate Nome roadside Arctic grayling fisheries to maintain populations with characteristics that users presently consider to be producing a high quality sport fishery and maintain minimum spawning stock abundances. Each population will be managed to maintain a minimum number of Arctic grayling >15 inches in length (sexually mature fish).

MANAGEMENT OBJECTIVES FOR SPECIFIC RIVERS

Maintain a population of Arctic grayling > 15 inches in length in index sections of the following rivers at these levels:

River	Section	Section Length	#>15 inches
1.	**Niukluk River (Council to Casadepage River)**	**14 mi**	**3,500**
2.	**Fish River (Cache Cr to lower end of canyon)**	**16 mi**	**4,500**
3.	**Pilgrim River (7.5 mile section below bridge)**	**7.5 mi**	**350**
4.	**Snake River (Boulder Creek to bridge)**	**12 mi**	**600**
5.	**Sinuk River**	**25 mi**	**1,000**
6.	**Nome River (Hobson Creek to weir)**	**26 mi**	**2,000**

The numbers of fish by river section in rivers were determined from past estimates of abundance of Arctic grayling within the size ranges and sections noted (numbers 1-5), where it has been shown that populations are supporting existing levels of effort and harvest. For the Nome River, the number is a desired number of fish >15 inches that is

believed would sustain a modest level of harvest based on the river's accessibility and the amount of Arctic grayling habitat available.

It is likely that levels of fishing effort will increase at some time in the future. Effort level is something that managers cannot control, and as this occurs, harvests and populations will continue to be monitored to ensure that the grayling stocks are not adversely impacted. Reduction of daily bag limits is a tool that may be needed in the future to decrease the risk of negatively impacting the size structure and abundance of Arctic grayling populations if increased effort levels result in harvests that may reduce populations below these threshold levels.

Providing diversity of opportunity in the form of the various harvest options for Arctic grayling is built into current management practices.

RESEARCH ACTIVITIES

The intent of the Sport Fish Division is to continue to conduct stock assessment projects on Arctic grayling populations in Nome roadside streams. The success of this management plan cannot be measured without periodic assessment of the Arctic grayling populations. It is recommended that assessments on individual stream index areas be conducted once every five years to determine if the regulatory framework for each stream is proper for maintaining the population at the desired level.

TASKS ALREADY ACCOMPLISHED

1. The regulatory structure in place should regulate harvests that result in sustaining populations with at or above objective levels. Baseline biological information on the grayling population has been collected during the past 12 years of stock assessment.
2. A research program has been developed that should provide the data necessary to measure the success of the regulatory structure in relation to the stated objectives given the dynamic nature of changing fishery characteristics.

IMPLEMENTATION

1. Population abundance and size structure assessment will be undertaken in each stream at least once every five years to measure the effectiveness of regulations to maintain the structure of a given population.
    A. If assessments indicate that the abundance of Arctic grayling has fallen below the thresholds set in this plan, management actions will be taken to reduce harvest.
    B. If assessments indicate substantial increases in abundance of Arctic grayling larger than 15 inches size composition, Sport Fish Division would consider supporting a proposal allowing additional harvest of grayling on a river by river basis, if there is strong public support.
    C. Restoration efforts for the Nome River are underway. If the population can be restored to the threshold level identified, subsistence harvests and catch-and-release fishing will be considered.

Research plans must include periodic population assessments that will enable populations to be monitored so the success of this management regime may be measured.

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